7A Flight Readiness Review (FRR)

International Space Station Program

Agenda

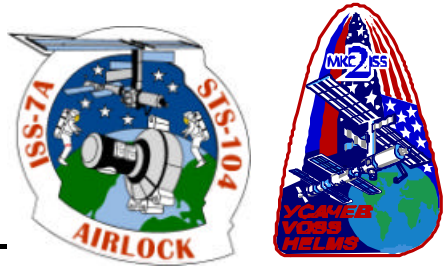
Mission Overview	Hubert Brasseaux
Vehicle Readiness	Steve Porter
Program Integration Readiness	Caris Hatfield
Avionics/Software Readiness	Richard Swaim
Summary	Hubert Brasseaux

7A Flight Readiness Review (FRR)

Mission Overview

International Space Station Program
June 28, 2001

Agenda



- ISSP 7A Program Reviews
- Stage Overview
- Stage Mission Priority Summary
- Spacelab Logistics Double Pallet Manifest
- Airlock
- ISS Stage 7A Consumable Status
- Configuration Status

ISSP 7A Program Reviews

Launch Package Assessment (LPA), May 1, 2001

- Addressed the launch package readiness for integration into the Orbiter.
- Successfully completed and authorized to complete payload processes.

Stage Operations Readiness Review (SORR), May 18, 2001

- Addressed the CoFR 1 & 2 requirements for cargo elements, middeck stowed hardware, launch package, personnel, facilities, and operations and their readiness to proceed to launch 7A on 6-20-01.

Delta Stage Operations Readiness Review (Delta SORR), June 18, 2001

- Addressed SORR open items and new items identified after the original SORR.
- Authorized to proceed to launch 7A on 7-12-01.
- Delta SORR Exceptions and Action Items:
  - Treadmill Operations Protocol
  - 2-Hour Pre-breath Protocol Approval
  - 1553 Chipset/Loop Back Software Patch
  - Over-current protection on ACU
  - Operation Plan for CANADAARM2 software
  - SSRMS Load Capacity

Increment Overview

Increment Start: Flt 5A.1 launch (8 March 01)

Increment End: Flt 7A.1 undock (14 August 01)

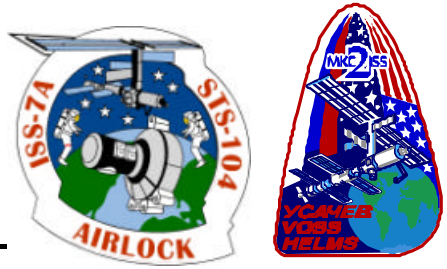
Increment Duration: 136 days

7A Stage Duration: 23 days

Crew:

- **ISS2-1: Rosaviakosmos/Yury Usachev**
- **ISS2-2: NASA/James Voss**
- **ISS2-3: NASA/Susan Helms**

7A Stage Mission Priorities



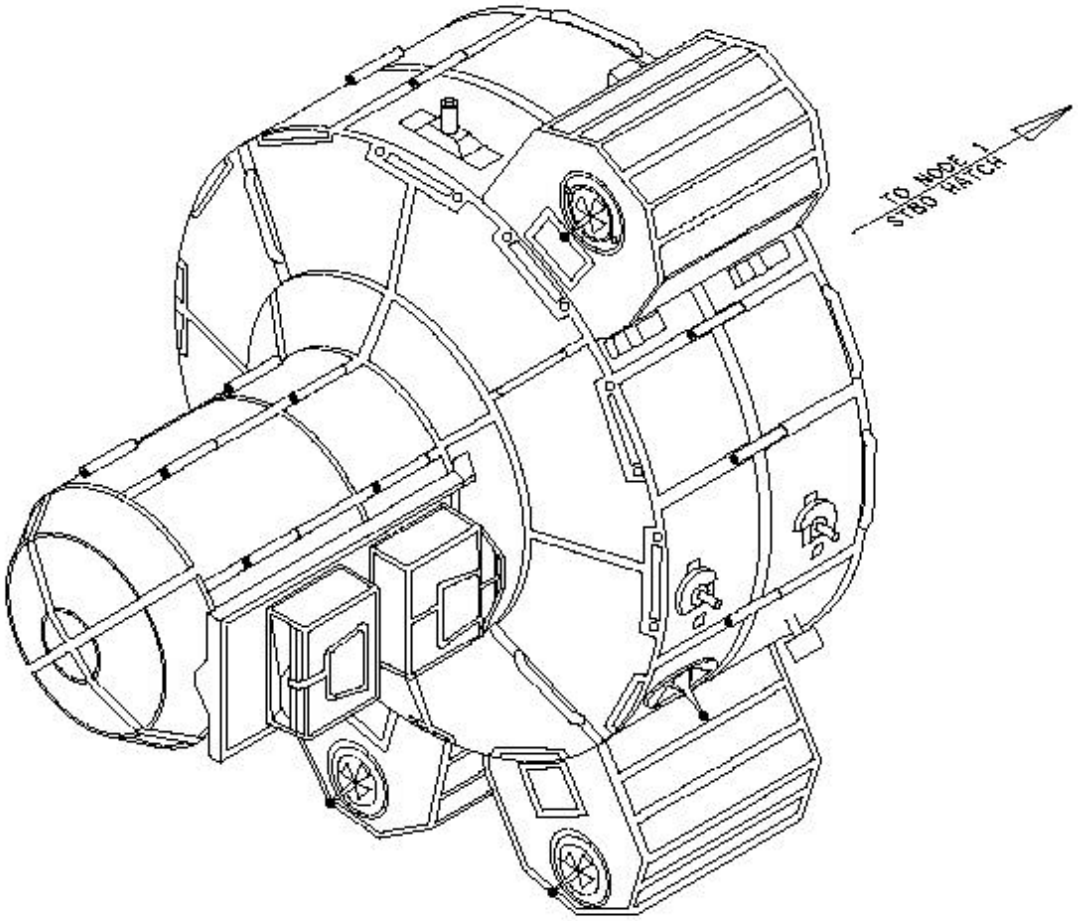
1. Perform handover preparation
2. Perform US/Russian maintenance activities for those systems with no redundancy or those systems required as a Launch Commit Criteria for the next flight
3. Complete US Airlock outfitting
4. Perform 4P cargo and propellant transfer
5. Perform US/RS medical operations (12 crew hours/week)
6. Swap ZSR #111 from LAB1S1 With ZSR #186 from NOD1P4
7. Reconfigure EXPRESS Racks 1 and 2 for 7A.1 utilization
8. Relocate BBND from LAB1P1 to LAB1D3 prior to 7A.1 docking
9. Perform prepack required for Flight 7A.1
10. Perform hardware staging required for Flight 7A.1
11. Perform training and preparation require for Flight 7A.1
12. Perform software load updates required for Flight 7A.1 (ground command)
13. Perform on-orbit debriefings
14. Perform US/Russian Payload Operations (average 30 crew hours per week)
15. Perform Personal Radiation Protection (PRP) Dosimeter Radiation monitoring
16. Install the experimental video complex (LIV)
17. Install the air decontamination assembly “Potok”

7A Stage Mission Priorities Con't

18. Install the Revitalization subsystem (atmosphere scrubbing filter assembly A-2)
19. Perform reboost if required
20. Perform US/Russian maintenance activities for those systems with redundancy
21. Perform US/Russian Payload Operations (remaining hours)
22. Perform US/Russian Medical Operations (remaining hours)
23. Perform remaining US/Russian maintenance activities

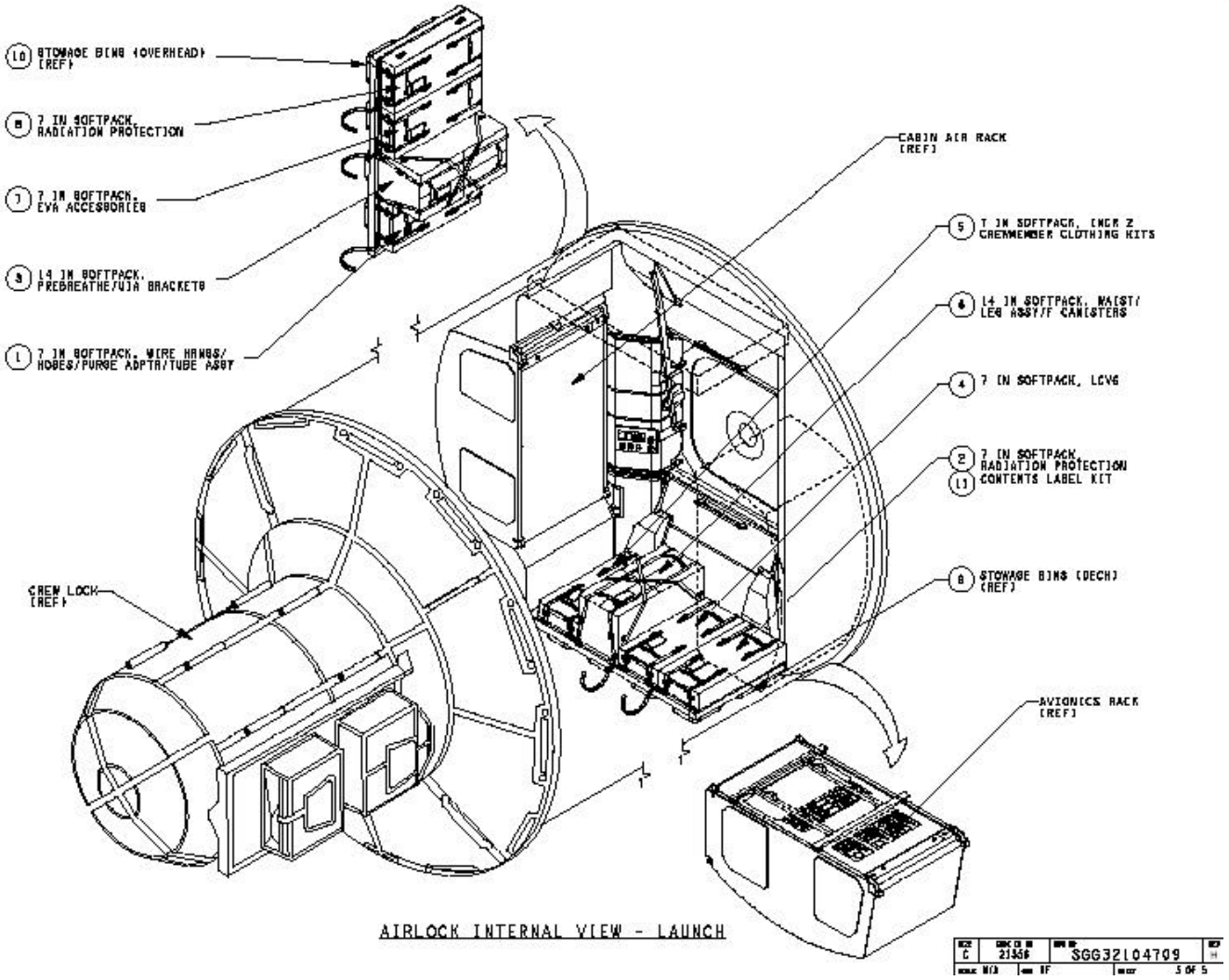
Note that we anticipate several Stage 6A items to be deferred to this stage….

Airlock On-Orbit

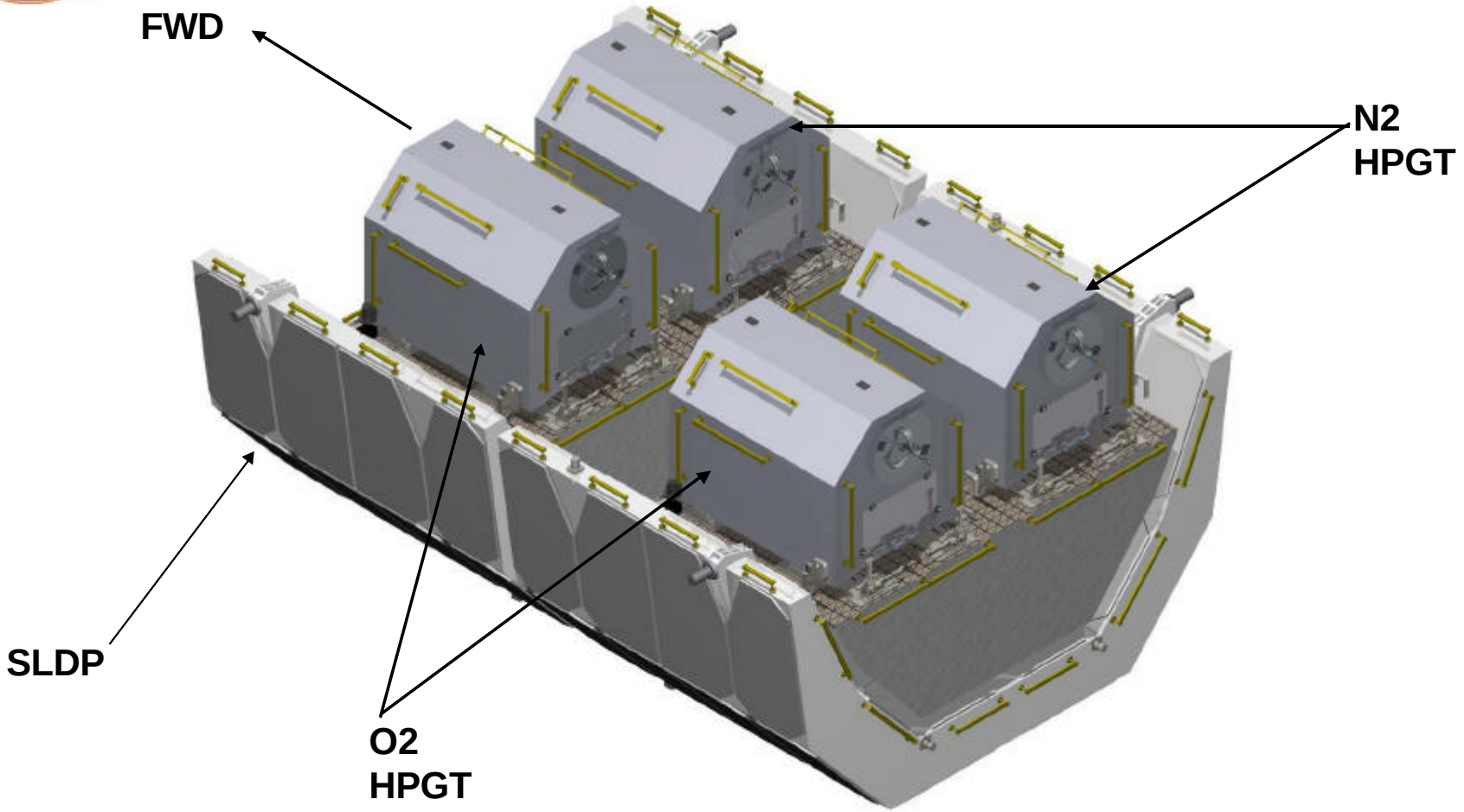


AIRLOCK EXTERNAL VIEW

Airlock Ascent Configuration



Spacelab Logistics Double Pallet Ascent Manifest

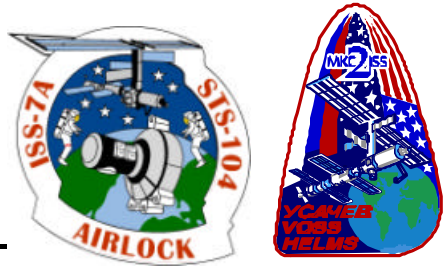


(Ascent)

Significant Hardware

- Airlock Hardware
- Treadmill Vibration Isolation System (TVIS) Chassis
- Contingency Exercise Surface (CES)
- Protein Crystal Growth -- Enhanced Gaseous Nitrogen (PCG-EGN)
- Protein Crystal Growth – Single Locker Thermal Enclosure System (PCG-STES) Return
- Portable Computer System (PCS)
- Waste Containment System (WCS) for ISS
- IMAX3D
- IMAX Cargo Bay Camera – 3 Dimensional (ICBC3D)
- MDM
- Disk Drive Cartridge (DDC)
- S-Band Cable
- RPCM Type V
- Ragul Communications System

Stage Utilization



US Payloads

- **HRF Rack-1**
- **EXPRESS Rack 1**
  - ADVASC
  - CGBA
  - CPCG-H
  - MAMS
  - SAMS-II
  - PCG-STES (2)
- **EXPRESS Rack 2 (ARIS)**
  - ARIS ICE
  - EXPPCS

- **Crew Earth Observations**
- **EarthKAM**
- **Bonner Ball**
- **DOSMAP**
- **HRF Torso**
- **MACE II**
- **Interactions**
- **PCG-EGN**
- **Hoffman-Reflex**

US SDTOs

- No utilization SDTOs

Stage Utilization (cont)

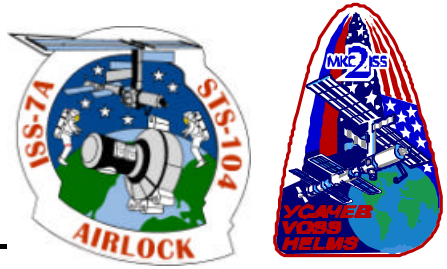
Russian Payloads

- Paradont
- Prognoz
- Cardio
- Bradoz
- Farma
- Uragan
- Massopeereos
- CPCF-2
- Vzgliad
- Biosphere

Russian SDTOs

- Identification
- Tenzor
- Izgib
- Privyazka
- Iskazheniye
- Vektor-T
- Meteroid
- Infrazvuk-M

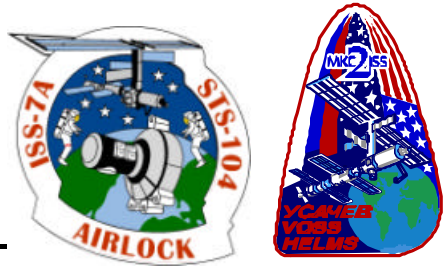
ISS Stage 7A Consumable Status



- **All consumables have been reviewed and are healthy for the 7A Stage**
  - ISS propellant reserve requirement is met
  - Food will be 13 days below the skip cycle
    - **33 days will remain as of August 5th**
  - EDV, KTO, KBO and SWC requirements are met above skip cycle
  - Oxygen cassettes are maintained at above the skip cycle throughout the stage for maintenance protection

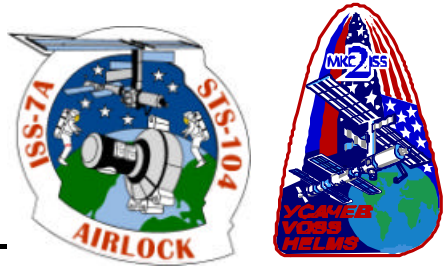
    (assumes working elektron)
  - LIOH is above skip cycle requirement
  - Crew provisioning requirements are met
  - Water is maintained at well above the skip cycle throughout the stage
  - Details are found in backup charts.

7A Configuration Status



- All 7A approved changes including waivers, deviations, and exceptions, have been identified and incorporated. (except as noted in backup charts).
- The 7A as-built configuration has been reconciled with the as-designed baseline (except as noted in backup charts).
- 7A open work has been identified and will be tracked to closure.

Launch Commit Criteria Statement



- **All Stage Readiness Requirements and Stage Launch Commit Criteria have been verified GO.**
- **Applicable Flight Rules are in compliance with the Stage.**
- **There are no 7A Cargo Element Launch Commit Criteria.**

Vehicle Office

ISS
Vehicle Office
Flight Readiness
Review

06/28/01

Flight 7A
FRR Agenda

On-orbit Summary	S. Gahring

Special Topics:

HPGT Paint Peeling	T. May
7A EVA / Plasma Control Plan	B. Eliason
Airlock Sample Port	C. Vaughn

Flight 6A Configuration

On-Orbit Hardware Status

Issues	New Since 6A FRR	Impact to 7A Operations	Topic to be Presented	Additional Ground Testing or Open Work	On-Orbit Repair scheduled or required
C&C MDM Problems	Yes	No	Yes (Avionics)	Yes	No (complete)
Canadarm2 Planned Testing	Yes	Yes	Yes (OM)	Yes	Yes
BGA Rotation High Current	Yes	No	Yes (Vehicle)	?	?
MCA Operations	Yes	Yes	Yes (Vehicle)	Yes	Yes (R&R complete)
CDRA	Yes	No	Yes (Vehicle)	Yes	?
Water Vent Problems	No	No	No	No	Fixed
CBM FOD	Yes	Yes	Yes (Vehicle)	Yes	Yes
Ku Band Acquisition Issue	No	Yes (Limited)	Yes (Avionics)	Yes	No
Ku Band Gimbal Temps	Yes	Yes (Limited)	Yes (Avionics)	Yes	No
RPCM Health Flags.	Yes	No	Yes (Vehicle)	Yes	Yes
TVIS & IRED	No	Yes	No	No	Yes (TVIS spare, IRED IFM)
SM Air Conditioner #2 (SKC-2) Failed	No	No	No	No	No (Repaired)
Vozdukh Operation on 2 of 3 CO2 Beds	No	No	No	Yes	Yes
SM Rapid Depress Algorithm Disabled	No	No	No	Yes	Yes (on Ground in Russia)

On-Orbit Hardware Status (cont'd)

Issues	New Since 6A FRR	Impact to 7A Operations	Topic to be Presented	Additional Ground Testing or Open Work	On-Orbit Repair scheduled or required
CMG2 Current Spikes	Yes	No	No	No	No
CMG1 & 2 Loss of Comm	Yes	No	No	No	No
CMG Survival Heater	Yes	No	No	No	No
MCOR	Yes	No	Yes (Avionics)	No	No
FSS	Yes	No	No	No	No
Regul System	Yes	No	No	Yes	Yes (Stage 7A)
ESP Spares (DCSU, PFCS)	Yes	No	No	Yes	?
SM Battery Strings (Battery 6, PTAB 2)	Yes	No	No	No	No

What is Out of Configuration

- PL2 MDM removed to replace C&C1
  - Former C&C3 (non-op) currently in PL2 slot
- Various RPCMs that need refreshing
- Workarounds due to UOP trips
  - Redesign in Approval
  - Procedures in place
- EEATCS Stbd Radiator – one loop plumbed incorrectly – No Impact
- 1 of 4 Beta Gimbal Assembly (BGA) latching mechanisms not locked on Stbd 4 Bar assembly – No Impact
- SM rapid depress algorithm disabled – No Impact (Lab provides function)
- Vozdukh operating on 2 of 3 CO2 beds – No Impact (CDRA Single Bed available)
- TVIS – No Impact
- Internal Audio Controller – No impact
- ZOE Recorder

MCA Operations

- Observation -

  The MCA (Major Constituent Analyzer) has experienced hardware failures and hardware/software integration issues that required re-planning of the 10.2 psia operations for the airlock

- Discussion -

  The MCA is a mass spectrometer used to measure 6 constituents (N2, O2, CO2, H2O, H2, CH4) in the Station's atmosphere from various locations including the Airlock and coordinates oxygen addition through the INTSYS

  - Hardware failures have occurred which require R&R of ORU1 & 2

  The CSA-CP (Compound Specific Analyzer-Combustion Products) is a handheld battery-powered multi-gas monitor with electrochemical sensors for O2, CO, HCN, and HCl that can be used as a backup for the MCA

- Status

  R&R of MCA's 1& 2 is completed 6/24

  Operational workarounds have been developed for the use of the MCA at 10.2 psia airlock operations

  Operational plans for the use of the CSA-CP have been developed in the event of an MCA failure

  On orbit verification of CSA-CP and 10.2 psia operations procedure is planned in timeline

CDRA

- Observation -
  - The CDRA (Carbon Dioxide Removal Assembly) has experienced a failure of the check valve that isolates the system from space vacuum during the desorption of CO2
- Discussion –
  - Failure investigation of air save pump showed desiccant material in pump rotor area preventing rotation
  - The CDRA removes 6 person-equivalents of CO2 when operating with both CO2 removal beds
  - CDRA is a backup to the Russian Vozdukh
  - 22 days supply of LiOH (US and Russian) on board for contingency operations
- Status
  - Operational workaround has been demonstrated to operate with only one bed providing a 3 person-equivalent removal capability
  - Check valve R&R will not be attempted

BGA Rotation High Current

- Observation
  - 4B BGA motor current exceeded 1.0 A threshold for 4 minutes and was moded to directed position (nominal ~0.2 A, limit 1.35 A, absolute 1.5 A)
- Discussion
  - 4B BGA latch 2 was successfully engaged/disengaged during flight 6A, clearing the latch drag anomaly
  - Over next several days, anomalous motor currents reappeared, eventually resulting in high currents and a stall condition
  - The 2B BGA has also shown anomalous motor current signatures. These signatures are similar in trend, yet lower in magnitude.
  - Earliest R&R opportunity is UF-1
- Risk Assessment:
  - If necessary, 4B could be place in directed position, with 2B in rate mode
    - Power load is manageable
- Acceptable for Flight: Yes
- Status
  - 2B in nominally rate mode
  - 4B is currently in rate mode for on-orbit testing
  - Continuing to monitor high current events, various tests planned to isolate root cause
  - Recent testing of operations to mitigate BGA high torque are positive

Node 1 Starboard CBM FOD

- Observation:
  During Flight 6A EVA2, a connector that interfaced with the Starboard Node 1 ECOMM hatch plate came apart during demating. Potential FOD includes a wing-tab collar and a total of 5 screws from cable connectors 1 & 2

- Discussion:
  The 6A EVA crew searched the volume between the CBM MMOD cover and the hatch on two different occasions. No FOD was visible.
  FOD could interfere with Airlock berthing operations or migrate to hatch mechanism and jam latches in a closed or partially open position, preventing hatch opening
- Risk Assessment - Low
- Acceptable for Flight - yes
- Status
  Sealing surface will be inspected by EVA during Airlock berthing
  Crew trained for contingencies

On-Orbit Summary

- None of the other identified Items For Investigation (IFI) regarding the on-orbit configuration represent a constraint to the flight of 7A

- The MER/ESR personnel and facilities will be ready to support

Flight 7A
FRR Agenda

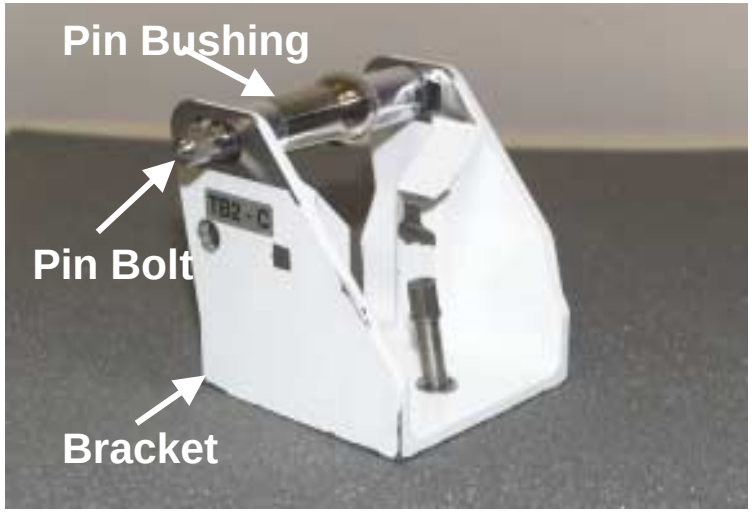
On-orbit Summary	S. Gahring
Special Topics:	
HPGT Paint Peeling	T. May
7A EVA / Plasma Control Plan	B. Eliason
Airlock Sample Port	C. Vaughn

Special Topic
HPGT Paint Peeling Issue

- Observation:
  15-5PH stainless painted with BMS10-90 (Chemglaze II A276) subject to peeling
- Discussion:
  HPGT Supt. Brackets painted to meet incidental touch temperature reqmts.
  - Paint is not adhering to the 15-5 stainless steel brackets
  - Paint will deteriorate after exposure to AO and UV environments
  - Search of other uses indicated HPGT thermal shields utilized same coating on 304 stainless

  Solution:
  - HPGT ORU Support Brackets - Reworked per PR's and FEC-Airlock-032
    - Removed paint on bracket surfaces above the M/D shields and MLI blankets.
    - Applied 1.5 inch wide Permacel P213 glass tape on bracket surface.
  - HPGT thermal shield brackets - Use as is per PR's
    - Paint adhesion and appearance is good based upon tape pull test and visual inspection
    - Thermal analysis indicates minimal degradation (D<2 F)
- Risk Assessment: Low
- Ready for Flight: Yes
- Status: CLOSED

Special Topic
HPGT Paint Peeling Issue



Support Brackets
Prior to Re-work

Support Bracket
Re-work Complete

HPGT Thermal Shield

Flight 7A
FRR Agenda

On-orbit Summary	S. Gahring
Special Topics:	
HPGT Paint Peeling	T. May
7A EVA / Plasma Control Plan	B. Eliason
Airlock Sample Port	C. Vaughn

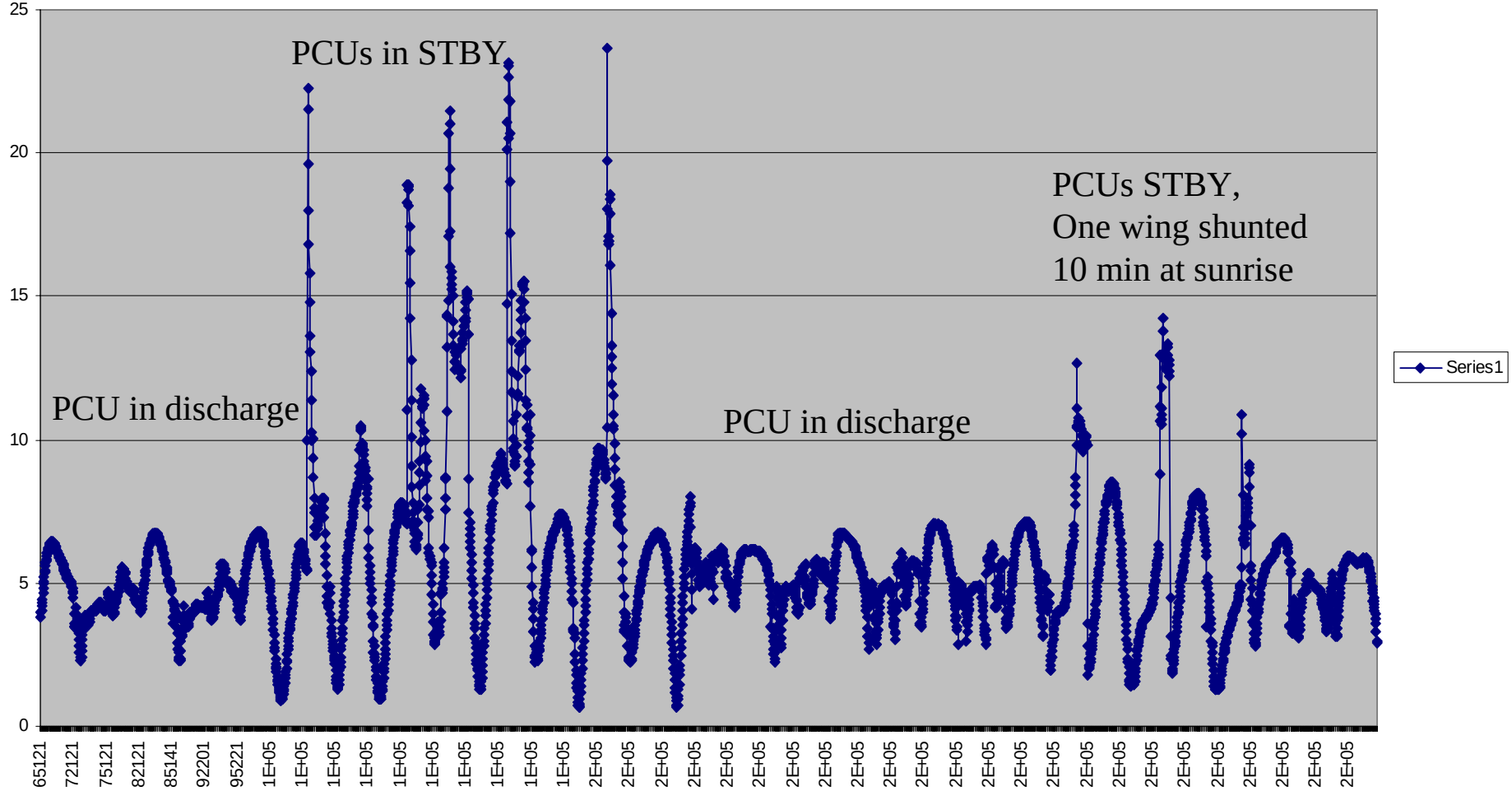
Special Topic
7A EVA / Plasma Control Plan

- EVA Arc control plan for 7A through 12A effectively the same as 6A
  - Both PCUs in discharge provide two of three required controls
  - One array to wake or one array shunted at sunrise provide third control
    - ISS floating potential will not exceed 30V negative if PCUs fail
  - Contingency plan (Flight Rule) for PCU failures in place

- Until 12A (next wing set), ISS potential will not exceed hazard limits
  - During non-EVA periods, PCUs are in STBY to preserve xenon

EVA PCU Plan supports through 12A

FPP Data with One Array Shunted



Recent PCU Data

- Additional testing has expanded operating envelope of PCU
  - Recently performed cold PCU ignition down to -3 deg C
  - Cold temperature did not degrade performance of PCU
  - PCU operation at negative beta angles to maintain temperature above 16.6 deg C is no longer required
  - Until 12A, PCUs can remain in STBY except during EVA
    - Allows significant deferral of planned PCU change-out for xenon depletion
  - At 12A, new array set electron collection may dictate constant PCU operation
    - With continuous PCU operation, xenon depletion of unit in use would be 18 months after 12A

Recent PCU Data cont'd

- During recent XPOP attitude of ISS, PCU 2 was put in discharge to allow evaluation of vehicle floating potential behavior vs. XVV
  - PCU emission current data allow indirect measurement of magnitude of PV array driven charging hazard
  - PCU emission current data in XPOP were comparable to XVV data at eclipse exit and post-shunting (peak floating potential excursion events)
  - Existing passive "third" EVA hazard controls (array management) are valid for XPOP through 12A
    - Result is expected because XPOP increases relative conductive surface area in ram compared to XVV

Flight 7A
FRR Agenda

On-orbit Summary S. Gahring

Special Topics:

HPGT Paint Peeling T. May

7A EVA / Plasma Control Plan B. Eliason

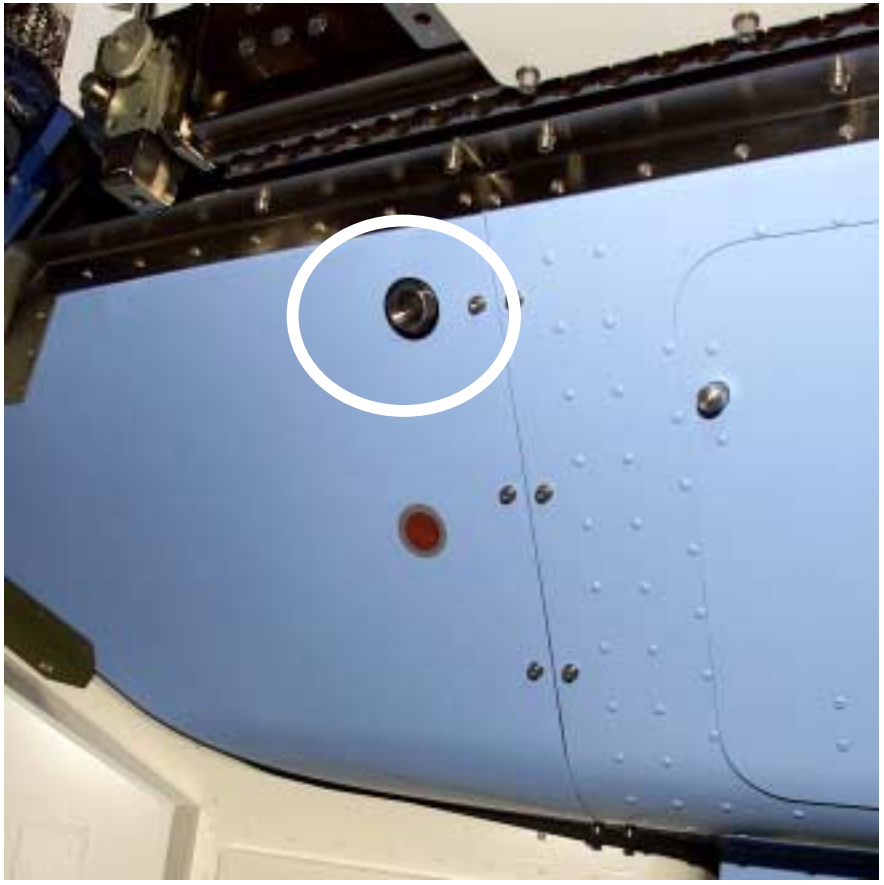
Airlock Sample Port C. Vaughn

Special Topic
Airlock Sample Port

- Observation:
  - Current Airlock sample port design could allow MCA to give erroneous partial pressure readings
- Discussion:
  - Airlock sample port is recessed into close-out
  - Current configuration of Airlock sample port could sample mostly behind the close-out
  - Sample port should be in the direct flow of the cabin, especially during depressurization to 10.2 psia and during 10.2 psia operations
    - Possibly cause the oxygen partial pressure to exceed 30% during Airlock 10.2 psia operations
- Risk assessment: Low
  - CSA-CP as redundant method to monitor oxygen partial pressure at any location desired
  - EVA dry run on flight day 6 will be used to determine actual offset compared with CSA-CP

Special Topic
Airlock Sample Port

Node 1



Airlock

Lab

Special Topic
Airlock Sample Port

- Acceptable for Flight: Yes

  If MCA offset is unacceptable the following short term options/procedures could be used

  - Close-out panel can be removed - timeline impact
  - Two CSA-CP can be used instead of MCA and CSA-CP

- Status: FRR exception 7A-FRR-001 submitted:

  Analysis of Airlock sample configuration is in work - ECD - 9 Jul 01

  - If analysis indicates problems long term design changes or procedural work-arounds will be implemented

7A FRR Robotics Readiness

OM/Program Integration

6/28/2001

C.A. (Skip) Hatfield
281-244-7766

Program Integration Topics

- **Readiness Overview (This presentation)**
  - Grapple Fixture Stiction
  - Introduction of Redundant string anomalies
  - Mission Success Protection
  - Software Release/Use plan
  - Forward Work
- **Special Topic: SSRMS Anomaly Resolution and CSA Status**
  - Chris Lorentz, Mission Operations Manager, Canadian Space Agency
- **Special Topic: Canadarm2 Loads during CBM Berthing**
  - Brian Richard, EBIT Chair, Boeing

Robotics Systems Go for 7A Launch

Grapple Release Stiction

- **During the last 3 Canadarm2 ungrapple operations, stiction has been noticed during release**
  - In the first case, the ungrapple included a rapid release followed by re-contact with the FRGF
  - The last 2 cases were less dramatic, and indicated a delayed release following the ungrapple command (crew reports indicate up to 10 seconds elapsed from command until end effecter movement off the FRGF)
- **Data analysis has revealed that 3 of 5 releases have been marked by variations of this phenomenon.**
- **This condition is caused by loads developed by constraining the manipulator on 2 grapple fixtures.**
  - The worst case incident was aggravated when the manipulator was not limped prior to release – procedures have been modified to require this action prior to release.
- **This condition is more severe that the Shuttle RMS due to higher back drive loads in the wrist roll joint.**
  - Shuttle RMS: 50 ft-lb (Note that shuttle shoulder joint back drive is 150 ft-lb)
  - Station RMS: 150 ft-lb
- **For Candarm2 the wrist joint is also the shoulder joint when reversing operating ends of the arm.**

Grapple Fixture Stiction (2)

- **Tolerance/design problems with the end effecter and/or the FRGF have been ruled out using a combination of preflight test, flight analysis, and ground testing conducted last week.**
- **The FRGF program maintains a master grapple fixture that all Canadarm2 end effecters were tested against pre-flight**
  - Master is built to maximum tolerance conditions with an additional 0.019 material stack.
  - Review of test results indicate no binding/resistance was encountered during test for any flight unit.
  - Thermal analysis indicates that temperature deltas between GFs and LEE will not cause a mechanical interference
- **This test was repeated last week using the identical SPDM end effecter, and again no binding was encountered.**
- **From the results of test and analysis, there is no issue with delayed release for unconstrained operations**
  - High Pressure Gas tank handoff to EVA
- **All 7A operations can handle expected release loads from this condition**
  - Airlock removal from payload bay
  - HP gas tank removal from payload bay
- **Forward work**
  - Refine procedures to minimize residual loads
  - Operations on 6/28 will utilize FMS to quantify on-orbit loads

Canadarm2 Redundant String Anomalies (1)

- **There were 3 significant intermittent faults discovered on the redundant string of CANADARM2.**
  - Wrist Roll joint Resolver to Digital Converter (RDC) BIT fault - Transient
  - Brake Voltage Faults – Cleared
  - Shoulder pitch Joint Remote Terminal communications (RT Comm) error – SW patch required
- **A software patch has been developed to correct the intermittent communications problem**
  - Operations Patch #1 delivered 25 June 2001
  - Patch will be operationally demonstrated on-orbit prior to 7A
- **Probable root causes have been identified for all of these items**
  - Corrective Actions are in place
  - Contingency plans also in place.
- **Long ground and on-orbit operational times imply marginal conditions have been exposed**
  - At the present time, both strings have been in operation for an equivalent of 2 years expected operation
  - Over 500 hours in operational state

CSA presentation will provide discussion of each fault.

Canadarm2 Redundant String Anomalies (2)

- **Extensive investigation has ruled out a common cause for these 3 faults**
  - It appears that chance has caused this, with no common root cause identifiable that would explain any grouping of these events
- **Intermittent RDC BIT errors may occur on either string**
- **ACU/Brake fault is isolated to the single Arm Computer Unit on the redundant string.**
- **Investigation has revealed the 1553 chipset at the root of the Joint RT Comm fault is also used in the Robotics Workstation, Arm Computer Unit, Video Distribution Unit, and Latching End Effecter**
  - ACU has extremely low likelihood of susceptibility to this faults
  - Analysis indicates the RWS Display & Control Panel, VDU, and LEU *may* be susceptible to this fault, and a contingency software patch is in work.
  - Operations Patch #2 will be available 9 July 2001 as a contingency if required.
- **Program has action to review the process by which information on parts problems is disseminated and take corrective action as required**

MSS Software Utilization Plan

- **Two software patches are required to completely protect for the 1553 chipset issue**
  - Operations Patch 1 for all 14 Joint Electronic Units (7 in each string)
  - Operations Patch 2 for VDU, LEU, RWS issues (contingency only)
- **Operations Patch 1 loaded on Vehicle 25 June 2001.**
  - Consists of baseline software plus new versions of Joint Control Software (JCS) and Arm Host Software (AHS)
  - Will be used for all subsequent operations through 7A
  - Patch will annunciate to the ground the RT comm fault should it occur
- **Operations Patch 2 will be available on 9 July 2001**
  - Consists of Operations Patch #1 content plus another version of AHS, LEE Control Software, and Workstation Host Software
  - Will be kept in reserve in the event RT fail flags occur on VDU, RWS or LEU
  - Considered to be very low probability.

Software Test Plan

- **Operations patches will be tested with a combination of ground and on-orbit testing**
- **Ground testing will be conducted at the component level and system level in Canada**
  - For example, the Joint Control SW is tested at vendor EMS, where a high fidelity unit allows the injection of the 1553 fault and observe SW reaction
  - At the Canadarm2 level, again a high level hardware representation of the affected ORUs allow the fault to be injected and observe SW reaction to the fault
  - This logic applies to all affected hardware items
- **Operations Patch 1 will be tested on the flight vehicle starting this week as the primary software on the flight vehicle**
  - Will be part of the weekly operations until launch
- **Operations Patch 2 will not be tested on the flight vehicle prior to launch since it is being held in reserve**
  - Operations Patch 1 will provide demonstration of the correction technique
  - Will be ground tested as above on high fidelity ground hardware

Mission Success Protection

- **Mission Success is assured through multiple paths.**
- **Presently, we have 2 functioning CANADARM2 strings**
  - Fully operational since 7 June (day 158)
  - Technical Rationale in place to support probable root cause for all faults
  - SW Patch (Operations Patch #1) will be delivered on 24 June (needed) to protect for 1553 RT faults
  - Spare ACU in place for brake fault if required
- **EVA options in place to support driving the CANADARM2 to Airlock keep alive position if required and to install 2 of 4 O2/N2 gas tanks with SRMS support**
  - Can protect for loss of both 1553 strings
- **Procedures in Place to alleviate loads during Canadarm2 Airlock berthing operations**
- **Operations plan for recovery from faults will proceed in following sequence**
  - If failure occurs on operational string, then switch to second string
  - If second string fails, then use EVA to move airlock to keep alive position
  - Recover at least 1 string (depending on fault, may include additional SW such as ops patch 2, ACU replacement, etc)

Forward Work

- **Complete Contingency patch for Robotics Workstation, VDU, and LEE Control Unit**
  - Current Target is 9 July 2001
- **Conduct alternating string demonstrations of continued CANADARM2 performance**
  - Opportunities exist every Tuesday (limited) and Thursday through launch
  - Plan developed to utilize this time to gain additional confidence, maintain crew proficiency.

Conclusion

- **CSA/MDR certify that CANADARM2 is ready for 7A mission at this time**
- **OM 7 also certifies that CANADARM2 is ready for 7A mission at this time**
- **There are no safety constraints**
- **A robust plan is in place for mission success**
  - Working Prime String
  - Working Redundant String
  - Anomalies experienced on redundant string explained/workarounds in place
  - EVA keep alive option in place as last resort

Robotics Systems Go for 7A Launch

Canadian Space Agency | Agence spatiale canadienne

7A Flight Readiness Review
Robotics Status

Chris Lorenz

Manager, Mission Operations, CSA

Canada

7A FRR: Robotics Status

- Overview
  - IFI/Anomaly status
  - Current Canadarm2 Status
  - Conclusion
  - Back-up slides (info only)

7A FRR: Robotics Status

- IFI/Anomaly Status:
  - Thirteen (13) IFIs encountered with Canadarm2 to date. Three (3) were considered threats to 7A.
  - IFI-393: Wrist Roll (WR) RDC Bit Fail
  - IFI-395: Redundant String Arm Control Unit (ACU) Brake Voltage Error
  - IFI-409: Shoulder Pitch (SP) Joint Electronics Unit (JEU) Anomaly

7A FRR: Robotics Status

- IFI-393: Wrist Roll RDC Bit Fail (Redundant string)
  - Occurred once on Day 137/17 May 01;
  - This fault caused the Canadarm2 to safe automatically. The fault cleared immediately, and operations continued;
  - Malfunction procedures lead to the conclusion that this is a transient (as does the signature);
  - Two (2) probable causes exist for this signature:
    - Transient due to noise on SIN/COS or 3kHz signal;
    - Single Event Upset (SEU) - ISS was at high latitude at occurrence;
  - Fault analysis for either cause indicates a very likely transient condition;
  - This event is considered a nuisance item that may reappear, but that can be cleared immediately without delaying operations.

This is not a constraint for flight

7A FRR: Robotics Status

- IFI-395: ACU Brake Voltage Error (Redundant String)
  - Occurred on Day 137/17 May 01 - following RDC Bit Fail;
    - Three (3) separate messages indicating loss of brake bus voltage. This fault causes automatic safing (and brake application);
  - The signature was repeated on the next six (6) attempts to release brakes:
    - Twice immediately after the initial fault, and again 5 hours later;
    - Three (3) more times during brake diagnostic tests conducted 9 hours later;
  - A similar signature has not been seen following 50 successful brake tests over 28 days:
    - Leaving the brakes off for long periods has not triggered the failure;
  - Fault analysis indicates one probable cause:
    - Short on ACU Brake card causes erroneous current limiting which leads to voltage loss under loading conditions;
  - Fault has cleared with no indication of recurrence.

This is not a constraint for flight

7A FRR: Robotics Status

- IFI-409: Shoulder Pitch (SP) JEU Anomaly (Redundant String)
  - Occurred on Day 143/23 May 01, Canadarm2 was in operational state;
    - Two signatures seen: (i) Fail to set RT address during initialization, and (ii) Fail to communicate in standby/operational (2 of 3 occurrences);
  - Fault persisted until Day 158/7 June 01, and then cleared during diagnostic tests;
  - Subsequent diagnostic patches have confirmed that JEU data is being transmitted/received correctly;
  - Fault analysis indicates probable cause:
    - Loop back test;
  - Investigation has revealed a known issue with 1553 chips from this vendor (susceptible to intermittent loop back function errors);
    - Failure signature matches chip exception exactly;
  - Loop back fault can be masked via patch without loss of arm capability.

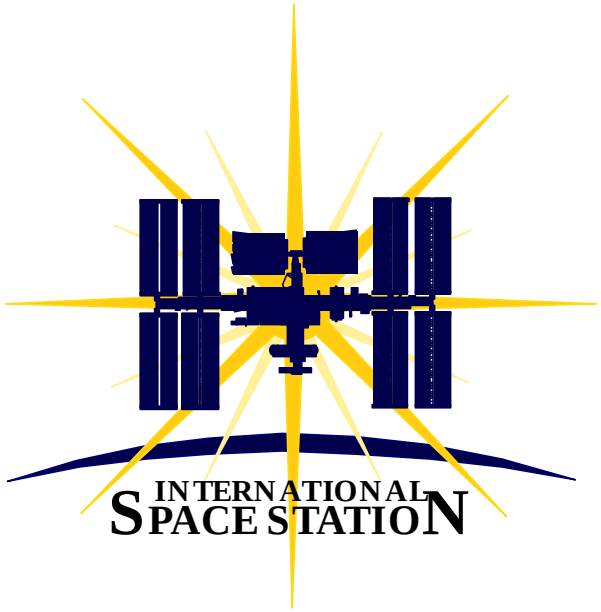
This is not a constraint for flight

7A FRR: Robotics Status

- Current Canadarm2 Status:
  - The Canadarm2 has two fully functional operating strings. Airlock installation dry-runs have been successfully executed on both strings;
  - Canadarm2 has been in the operational state for over 400 hours, more than five of which are actual arm motion;
  - Software patch to address the 1553 loopback fault in the JEU delivered to MBF on 25 June 01 and loaded onto Canadarm2 on 26 June 01.
  - Software patches to address the 1553 loopback fault in the RWS DCP, LEU and VDU are expected to be delivered to CSA on 9 July 01. Plan is to hold these patches on the ground unless required to address an on-orbit fault.
  - One (1) OCR remains outstanding: OCR#39 - POHS Performance Test. This is scheduled to occur today (28 June 01).

7A FRR: Robotics Status

- Conclusion:
  - Canadarm2 operations will continue right up to 7A launch - Tuesdays and Thursdays are planned robotics activity days.
  - Canadarm2 is GO for 7A launch.
- Questions?



7A Flight Readiness Review

Berthing Loads during CBM Capture

End-to-End Berthing Integration Team

Brian Richard/Boeing

June 28, 2001

International Space Station Program Office

Issue - Resolution - Summary

Issue

- **Canadarm2 and Airlock FRGF secondary structure Flight Planning Load Limits (FPLL) are exceeded should Canadarm2 safing occur during 7A CBM 2nd Stage Capture**
  - Problem resolution led by EBIT, with significant contributions from CSA, Boeing-HSV (CBM), NASA-JSC (DA8, DF, DX22, ER, ES)

Resolution

- **SES, HSV, MSFC analysis and test complete (details in backups)**
- **Developed a Berthing Procedure to maintain acceptable loads**
  - Hardware Providers (Lab, Airlock, CBM, Canadarm2) concur
  - All loads below agreed upon limit loads, No hardware damage

Summary

- **Closed exception 7A-SORR-004**

Ready for 7A in July 2001

Berthing Procedure

- **Goal is to use 4 latches to minimize loading risk**
  - Crew trained to achieve 4-RTLs
  - EVA can also determine RTL condition

- **Step 1: Perform Second stage capture with -1250 torque bias**
  - If 4-RTLs, allow 4 latches to pull to full seat or to stall
  - If 3-RTLs, allow 3 latches to pull to 130 degrees
  - Both options follow nominal 2nd stage capture philosophy but uses templates

- **If mechanism not fully seated, reset torque bias to -400, Go to Step 2**

- **Step 2: Perform remaining capture in increments starting from highest latch position ***
  - If 4 latches, increments of 10 degrees latch rotation (3 secs)
  - If 3 latches, increments of 5 degrees latch rotation (1.5 secs)

  * Requires Canadarm2 Brake removal to complete berthing

Berthing Procedure Recovery

- **Canadarm2 safes to Brakes-on**
  - Remove Canadarm2 brakes (recover C&C, switch strings, etc)
  - Continue procedure

- **Canadarm2 Brakes on permanently**
  - EVA release Canadarm2 brakes at 7 or 4 joints
    - Performing Canadarm2 Shoulder and Elbow joints EVA brake release analysis per MOD request due to limited access to Wrist joints
    - Use of EVA drive in this context is not nominal, but confirmed to be acceptable
  - Execute Capture command from current position to full seat

- **CBM latch failure**
  - CBM master controller will stop all latches
  - If 3 latches available, continue procedure for 3 latch case
  - If less than 3 latches, stop and assess options

Summary and Recommendation

Summary

- **Procedures developed that keep loads below an acceptable level during Airlock capture by the CBM even if Canadarm2 brakes are activated**
  - Procedure developed for either 3 or 4 ready to latch indications
  - Nominal maximum torque limit lowered
  - If additional torque is required, multiple step process defined
- **Crew is trained and flight control teams are ready for nominal and off-nominal situations during capture**

Recommendation

Ready for 7A in July 2001

Avionics & Software Office
NASA and Boeing

7A Flight Readiness Review

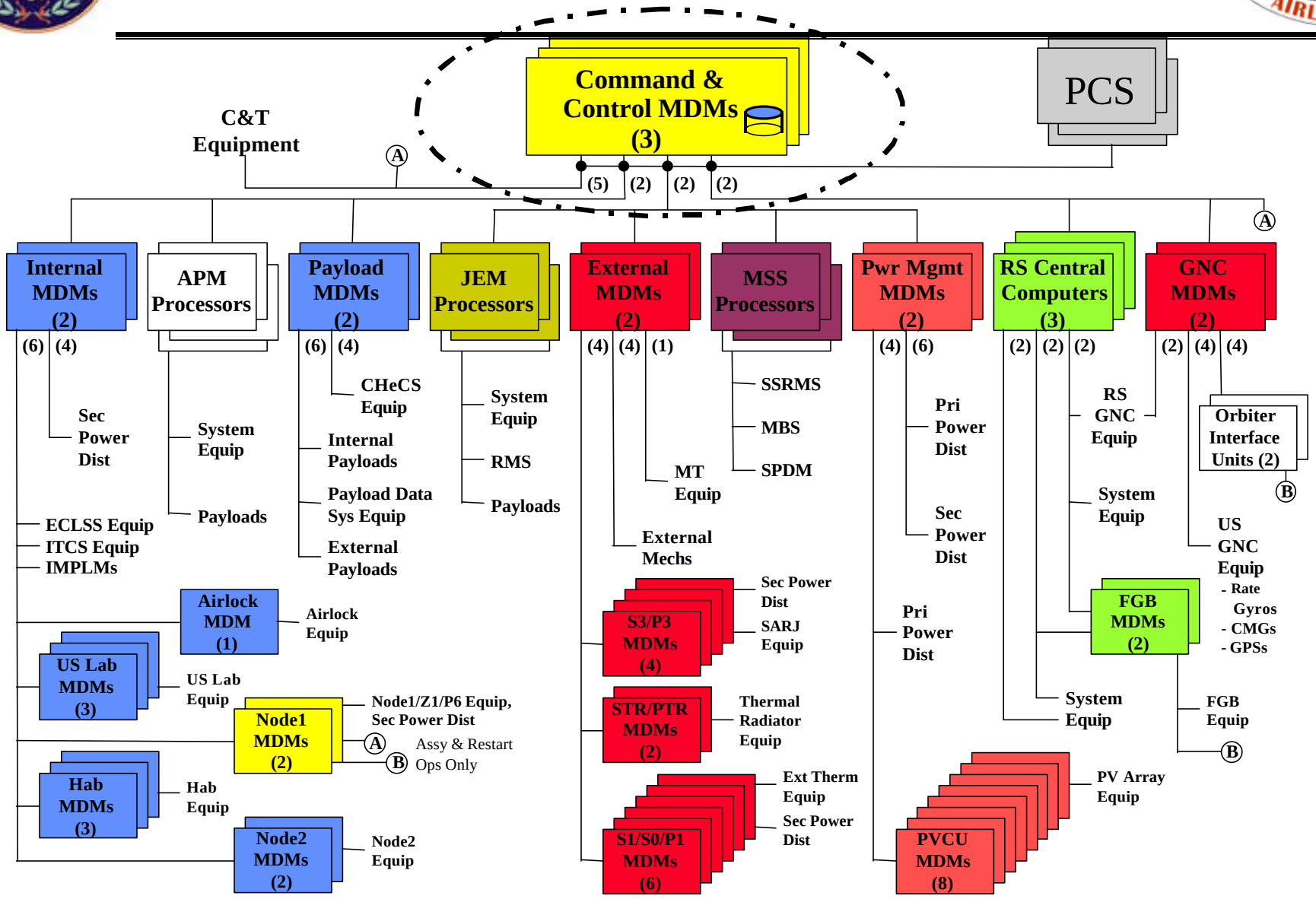
Richard Swaim - Boeing

June 28, 2001

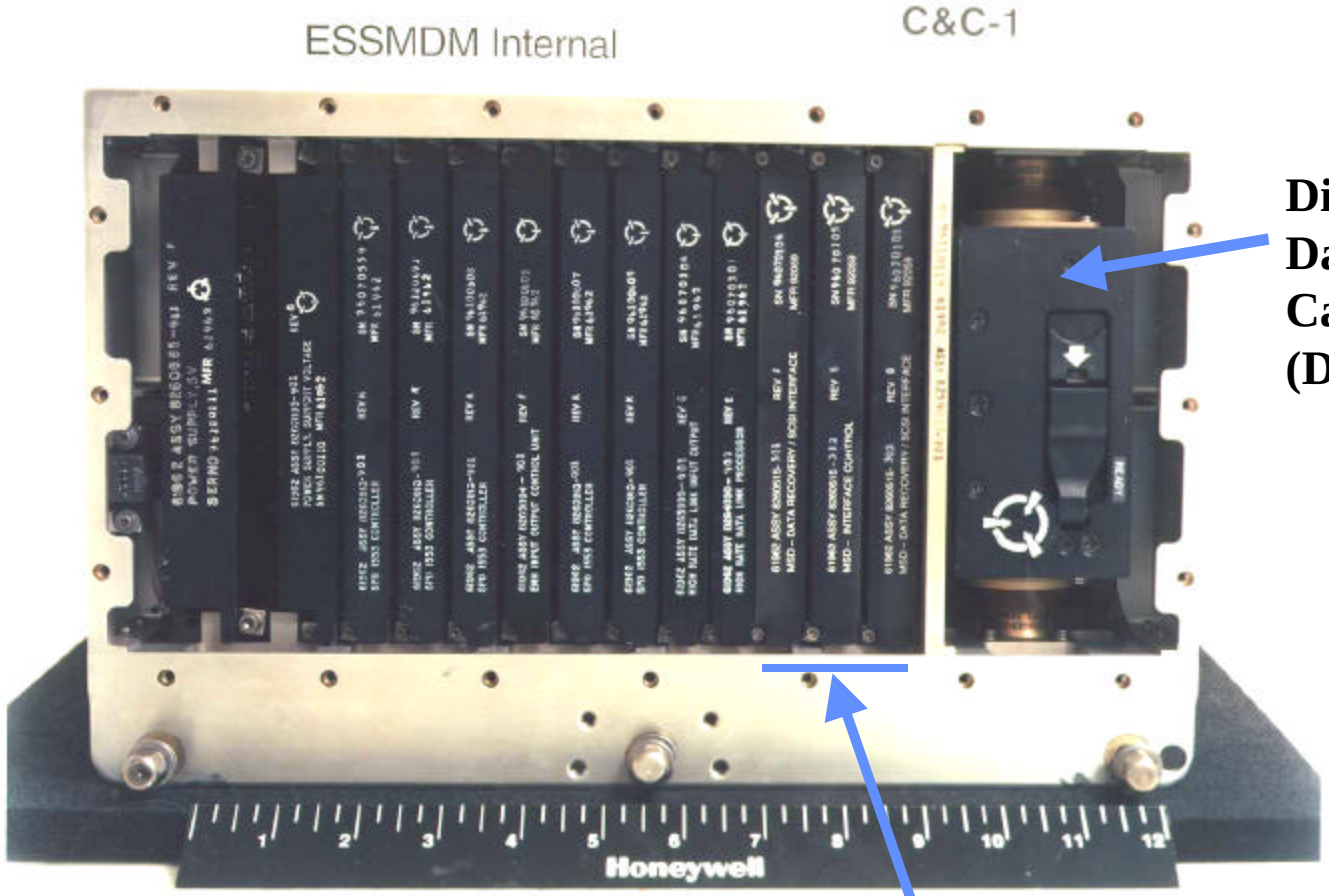
Avionics & Software
7A Agenda

- Command and Data Handling (C&DH) Hardware
  - Special Topic: Command and Control Computer Hard Disk Failure Anomaly resolution
- Communication and Tracking (C&T)
  - Special Topic: Ku Band Pointing
  - Special Topic: Ku Band Antenna (SGANT) Heater
  - Special Topic: Medium Rate Communication Outage Recorder (MCOR)
- Software (SW)
  - Plan to launch (PR's / CN's)
  - Station Program Notes (SPNs)

C&DH System Context



Mass Storage Device (MSD) Components in C&C MDM (Cover Removed)



Disk Data Cartridge (DDC)

A1-A3 MSD Electronics

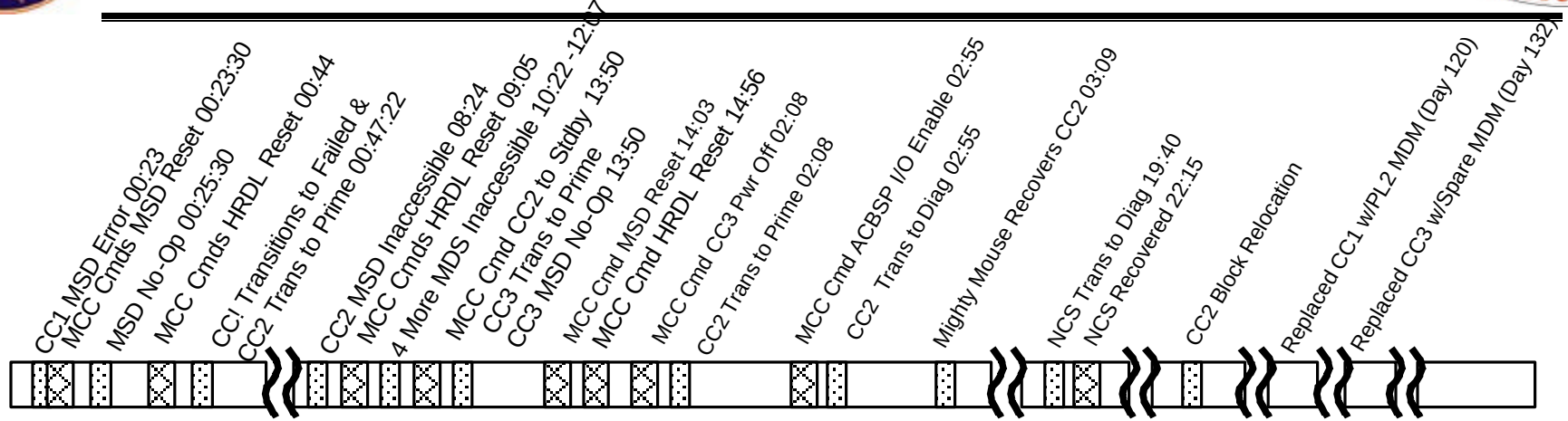
6A C&C MDM Anomaly Overview

- Successive events during the 6A mission resulted in the temporary loss of the CCS layer in the ISS control hierarchy
- Coincident with these events, failure or damage of the C&C MDM Disk Data Cartridges (DDCs) occurred, resulting in degradation of CCS capabilities
- All three C&C MDMs have been serviced and returned to full capability, and the system has been tested in 7A operational scenario
- Extensive analysis of the hardware, firmware, software, and operations contributions to these events has been performed
- Mechanisms & Procedures have been implemented to eliminate or reduce probability of recurrence, increase system visibility, and minimize impact of similar incidents

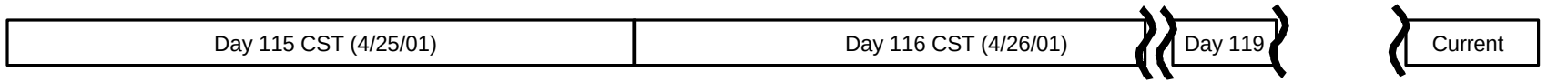
MSD Failure Consequences

- Non-Operational MSD in the primary C&C processor results in CCS Functional Degradation:
  - Inability to populate data for any new PCS display requested after failure (“Purple-D’s”)
  - Inability to provide initial program and data loads for SSRMS and GNC (cold start)
  - Inability to provide new reference frame data to SSRMS
  - Loss of Command Log Recording
  - Loss of ZOE “Ops Recorder” Function
  - Inability to stage transferred files through CCS disk
  - Inability to boot CCS MDM from disk if failure is persistent
- Functions not directly affected by MSD failure
  - Command Processing and Routing
  - Telemetry Gathering and Reporting

CC Failure Timeline



Prime	CC1	CC2	CC3	CC2		CC2	CC3
B/U	CC2	CC3				CC3	CC1
Stdby	CC3		CC2				CC2
Other		CC1 - Failed	CC1 - Failed	CC1 – Failed CC3 - Off	CC1 – Failed CC2 - Diag CC3 - Off	CC1 - Failed	



Relative timing not represented

LEGEND

MCC Commands

MDM Events

C&C MDM Failure Discussion (in order of occurrence)

- C&C 1 – Failure
  - Cause: C&C1 MSD hard failed
    - MSD on C&C1 was not spinning post transition to Failed State
    - Telemetry signature duplicated in ISIL
    - MDM returned on 6A- Postmortem on MSD by Raymond confirmed disk failure. 8 of 10 heads that read the disks are cracked.
    - Investigation ongoing as to what caused disk failure
  - MDM replaced with Payload 2 MDM and C&C software reloaded
- C&C2 – Hard disk Inaccessible errors
  - Most Probable Cause: MSD Inaccessible state resulted from SCSI I/O errors during ZOE and other on-demand disk accesses
    - Unusual number of SCSI or CRC errors as a result of disk access by ZOE and other on demand access
    - MSD on C&C-2 remained operational
      - HRDL reset commands are recovering MSD access per SPN 19188. Five HDRL resets commands executed successfully.
      - Frequency was impacting planned operations timeline.
    - Duplicated HRDL Lost Data Counter signature, including rate on the ground
  - Disk Drive Cartridge (DDC) replaced with unit flown on Progress

C&C MDM Failure Discussion

- C&C 3 – Failure when brought from Standby to Primary MDM
  - Cause: Data Indicates CC3 transitioned into a failed MSD.
    - MSD status No-OP upon Transition from Standby to Primary
    - Part of warm init requires an MSD access to read (“read disk detailed defects list”)
    - Difficulty has been in correlating the signatures for C&C 3
  - Cause of loss of telemetry and PCS connectivity: Ada Exception that results in application exit back to Task scheduler and the skipping of subsequent 10 Hz application calls.
    - As C&C 3 was the standby MDM automated SW exception handling was disabled per plan
      - Transition to Diag – Disabled
      - Ada Exception Safing - Disabled
      - MSD Fault Response - Disabled
      - HRDL Fault Response - Disabled
  - C&C MDM that failed to be returned on 7A for postmortem
  - MDM replaced and reloaded on orbit
  - Ada exception handling re-enabled for Standby machines
- C&C 2 to Diag., Mighty Mouse Initiation
  - Cause: S-Band ORU I/O Enable after activation of Binary Data Transfer (BDT) in CCS, causes Ada exceptions and Task Overruns
    - Tested 5/2, signature duplicated
  - Known problem associated with starting S-Band from an MDM in Standby

C&C MDM Failure Discussion

- NCS Transition to Diagnostics
  - Cause: Following MM execution C&C and Node MDMs time set to 1992 while GNC-1 remained 2001, this results in NCS resident PCU application to have a numeric constraint error (ADA Exception)
    - GNC MDM provides sunrise / sunset times which the PCS application uses (when application is enabled), regardless of the PCU being powered
    - Differential in time caused sunrise/sunset times to be a negative number- out of range.
    - The same code runs in both Node MDMs, with Primary controlling, both boxes went to diagnostics.
  - PR 20854 – ASCB approved patch to no-op this condition and the patch has been up-linked
- C&C 2 Disk Errors
  - On-going investigation by combined team of Boeing, Honeywell and Raymond
  - Related to SCSI errors
  - MSD replaced with unit launched on Progress

C&C MDM Failure Summary

- Chain of events was initiated by reported hardware problems with C&C-1 MSD (non-operational)
  - "Mighty Mouse" event destroyed residual data in MDM volatile memory, complicating analysis
- C&C-1 and C&C-3 MSDs were both non-operational after incident
  - Both drives fail self test and "spin-down" on-orbit after power cycling
  - C&C-1 analysis showed head damage consistent with on-orbit behavior
  - C&C-3 return to ground for analysis scheduled for 7A
- Software and procedural (20/20) problems in the off-nominal path created by the hardware failures further complicated the scenario
- C&C-2 Hardware Remained Operational Throughout Event

C&C MDM Failure Analysis Status

- MSD Hardware - Analysis continues for MSD fatal error trigger mechanism
  - C&C-1 Drive Data Recovery, Tear-Down, and Physical Analysis Complete
    - Lost on-orbit volatile data complicates distinction of cause from effect
  - Subsystem Telemetry Analysis Complete (further system level analysis ongoing)
  - Availability of C&C-2 & C&C-3 drives post 7A to provide additional insight
- Software and C&DH Procedures -
  - Problems identified in failure response have been thoroughly analyzed, root causes identified, and corrective action taken to prevent their recurrence
  - Given a similar scenario today, “Mighty Mouse” event would not occur
- Operations -
  - Planning for 7A operations conducted with the assumption that the MSD failure root cause would not be found / corrected prior to flight
  - Critical operation entry criteria designed for survivability despite MSD failures
  - Training / Dry-Runs of Critical 7A operations conducted with same hardware
  - On-board diagnostic, control, and re-load capabilities have been implemented to speed recovery and increase flexibility in the event of similar problems

Long Term Plan

- Mechanical Rotating Disk to be replaced by Solid State Memory
  - No moving parts
  - Improves reliability of SCSI interface
  - Reduced obsolescence and sparing issues
  - Increased capacity
- Prototype Solid State Units in place at SDIL and undergoing successful compatibility testing with CCS
- Program plan supports deployment this year
  - Available for phased deployment starting at 7A.1

Risk Assessment

- Risk Assessment – Low
  - Current configuration exceeds identified minimum requirements for 2 C&C MDM's with fully functioning hard disks (three currently available)
  - Disk Drives that have failed or have Disk Access Errors have been replaced
  - Operation's which increase the number, duration or complexity of disk drive operations are minimized during critical operations – reduces probability of SCSI/MSD inaccessible errors
    - No ZOE application enable on C&C- (ZOE Disable patch uploaded with 7A upgrades)
    - No file transfers between C&C and Payload MDM
    - No POIC commanding without real-time approval with ODIN
    - No commanding during HRDL resets- Needs to become 'standard operating procedure
    - Limit the number of PCS operational at any one time (e.g. Four – AFD, 2 USL, 1 SM)
    - No VTR Remote or LOCAL – C&C to VTR characterization test completed successfully
    - No HRDL Resets/Data load Resets until confirmation from C&C MER all required dumps are complete
  - Approach to recover from loss of some Primary CCS functionality during Flight 7A Robotics Operations developed tested and transmitted formally to the operations community
  - 7A Airlock Operations Dry-Runs with C&C MDM planned to be CCS Primary during actual mission operations
  - Time windows with maximum exposure to Disk failures are understood by operations community and contingencies planned for to mitigate threat to mission objectives
  - We have successfully recovered from multiple major anomalies. The team has gained valuable experience with difficult situations.

Acceptability for Flight

- Acceptable for Flight – Yes
  - For each of the failures
    - Failure mechanisms and reasons for secondary effects are understood
    - Root cause (triggering event) for the hard disk failures not yet identified, effects mitigated by plans below
  - Risk Reduction / Failure Recovery Plans in Place
    - Replaced failed hard drives
    - Minimizing hard disk access
    - Minimizing exposure of critical operation to a potential hard disk failure
    - Deploying equipment and procedures to recover from future failures
  - Hardware Configuration in place exceeds minimum Requirements
  - Successful Completion of confidence building tests demonstrates readiness to support 7A Critical Arm Operations

Special Topic: Ku Band Pointing

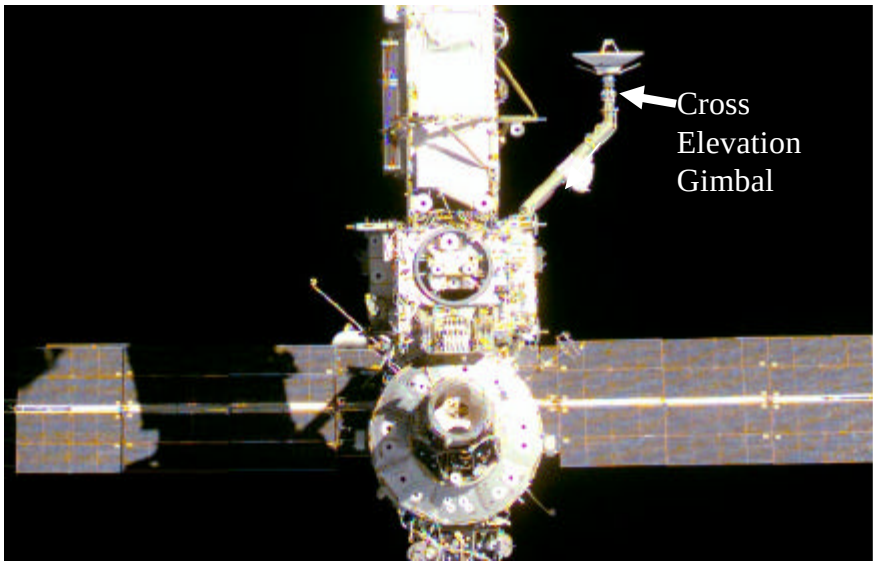
- Observation – five separate items for investigation
  - 1) IFI - 309 Static pointing Bias offset of ~ 5 deg identified on orbit
  - 2) IFI - 309 Inability to reliably acquire lock on TDRSS satellite -
  - 3) IFI - 308 Failure to recognize and recover from blockage
  - 4) IFI - 330 Radiation Inside Mask (Event Start 96/21:30)
  - 5) IFI - 421 Mask Radiation Alarm
- Discussion
  - 1) Root cause identified as Z1 antenna boom drawing interpretation error of ~4.6 degrees.
    - PPL developed and loaded on CCS to correct offset
  - 2) Problem traced to Ku Band starting spiral search on first attempt with stale pointing data. 2nd attempt starts before completing slew to new TDRS location prediction, thus hole in spiral search around target
    - Patch developed to send pointing data continuously to Ku Band equipment so that Ku Band slews to the new location during prior to attempting TDRS search.
  - 3) Problem traced to lack of hysteresis in algorithm that allows reset of receive power level during slow and noisy decay of forward link signal (PWRL)
    - Patch developed to change algorithm to declare loss of link at threshold level of -51 dB
  - 4) Ku-band equipment appeared to radiate within mask for 1 sec, but not all data support this. During recovery, procedural error caused ~40 sec radiation of Russian elements, but assessment concluded no deleterious effect.
    - Procedure being corrected by CR
  - 5) Drop lock patch contains a continuous retry feature where CCS commands the Ku system to attempt acquisition based on time elapsed, not location
    - With signal acquisition, even on noise, firmware commands turn on, then CCS mask software immediately turns it off – no radiation occurred - Workarounds still under investigation 6/21/01

Special Topic: Ku Band Pointing

- Risk Assessment - low
  - Operational with error-free transmission of data and video in Open-Loop mode with static bias loaded in CCS
    - 50 MBPS (planned operational rate)
    - Signal strength within 0.5 dB of auto-track performance
  - Open loop mode requires CATO to perform additional commanding
    - Basically 5 commands required on each TDRS pass
  - XPOP operations – (high accuracy RS Star Tracker data unavailable)
    - If attitude knowledge degrades to 1°, open loop pointing does not work
    - If attitude knowledge degrades to no worse than 2°, autotrack mode is available
      - Operations during early June demonstrate that the system can acquire and track TDRSS in XPOP
- Acceptable for Flight? - Yes
- Status
  - IFI's closed except 421
  - Static bias patch uplink and in use
  - Ku-Band S/W patch's loaded
  - Acquisition and Pointing operating nominally
    - Both Open Loop and closed loop (Spiral Search-then Autotrack) pointing functions in LVLH
    - Spiral Search – Auto track functions in XPOP

Special Topic
Ku Band Antenna Gimbal Temperatures

- Observations
  - Over time the temperature of the cross elevation gimbal of the Ku Band Antenna continued to gradually decrease
    - Documented at IFI 336
  - Testing revealed a failed heater circuit in the cross elevation gimbals
  - Pre-Mission planning set a minimum operating temperature of the Gimbals at 0 degC
  - Temperatures below the lower limits were observed in flight



- Discussion
  - A detailed review of relevant test data for the Antenna Assembly and its components indicates that revised operating limits can be used and preserve adequate margins of -20 degC for the Gimbal Motor and -30 degC for the Gimbal Encoder
    - Stepper motor design inherently protects gear train and other components from excessive torque
    - Recommendation approved by T&VCP 6/6/01, VCB 6/11/01 and ASCB 6/8/01
  - Implemented and operated within these limits

Special Topic
Ku Band Antenna Gimbal Temperatures

- Risk Assessment - low
  - Operating currently
- Acceptable for Flight?
  - Yes - fully functional and working.
- Status – Forward Work
  - Long term heater fix still under evaluation

Special Topic: Medium Rate Communications Outage Recorder (MCOR)

- Observation
  - Temperature issue
    - Nominal MCOR thermal operational limits are set from 27 degC to 39 degC.
    - On 4/11/01 the MCOR activation and check-out started. Since MCOR reached 40 deg C we commanded to shut down the unit. Documented with IFI 333, final closure ECD 7/2
  - Static Heartbeat
    - Additional failure (static heartbeat) occurred 5/15/01
  - Lost channel 4
    - On 6/21/01 MCOR failed to respond to commands
    - MCOR channel 4 functionality was lost but later restored.
- Discussion
  - MCOR Checkout and activation was completed
  - Temperature issue
    - Unit has been recording data normally (since 4/20) as commanded by POIC (DMC) .
    - During the C&C MDM problems, MCOR RT was disabled for about two weeks but the unit was left in the recording mode. While the MCOR status was not available via telemetry, RPCM current drawn indicated nominal functionality.
    - MCOR RT was enabled 5/7, and DMC has been exercising the nominal recording and playback functions during LOS and AOS. Maintaining a temperature range between 34 to 35 degrees C .
    - The issues (temperature increase above 40 degrees C, stoppage of observed watchdog timer via telemetry and power issues) during activation (before C&C MDM problem was observed) are resolved by ART
  - Static heartbeat
    - MCOR troubleshooting competed, successfully fixing one of the corrupted files. Unit operating normally since then.
  - Lost channel 4
    - MER IFI 445 was opened and analysis is currently in work. Currently both channels are functioning normally.

Special Topic: MCOR Temperature Excursions

- Risk Assessment - low
  - Operational risk mitigated by thermal monitoring on ground and thermal switches that are incorporated in the hardware to shutoff the unit automatically for high temperature.
- Acceptable for Flight?
  - Yes - MCOR fully functional and working.
- Status – Forward Work
  - Thermal tests have been conducted and the results analyzed to find the cause.
  - MCOR ART is generating a procedure for CATO to run periodic disk cleaning to avoid future disk corruptions. Crew intervention is required. Procedure to be used only when needed. MCOR ART on overtemp issue closed 6/19.
  - A spare MCOR unit has undergone bench review and is ready for packaging at KSC for 7A.1. DSSR decided not to expedite for 7A since the unit on orbit is functioning.
  - CR #5541 to modify software configuration file to change the telemetry thermal flag to 47 degrees C (with crew support for on orbit unit), needed to work with R2 release, was approved by ASCB.
  - A generic design change, proposed to modify fan speed inside the docking unit of MCOR, to alleviate thermal shutoffs was disapproved by ASCB

Eddie Mendoza
7A Flight Software Integration Manager
Telephone: 281-244-4412

7A Flight SW Plan to Launch

As of 6/26/01

7A Open Software Status

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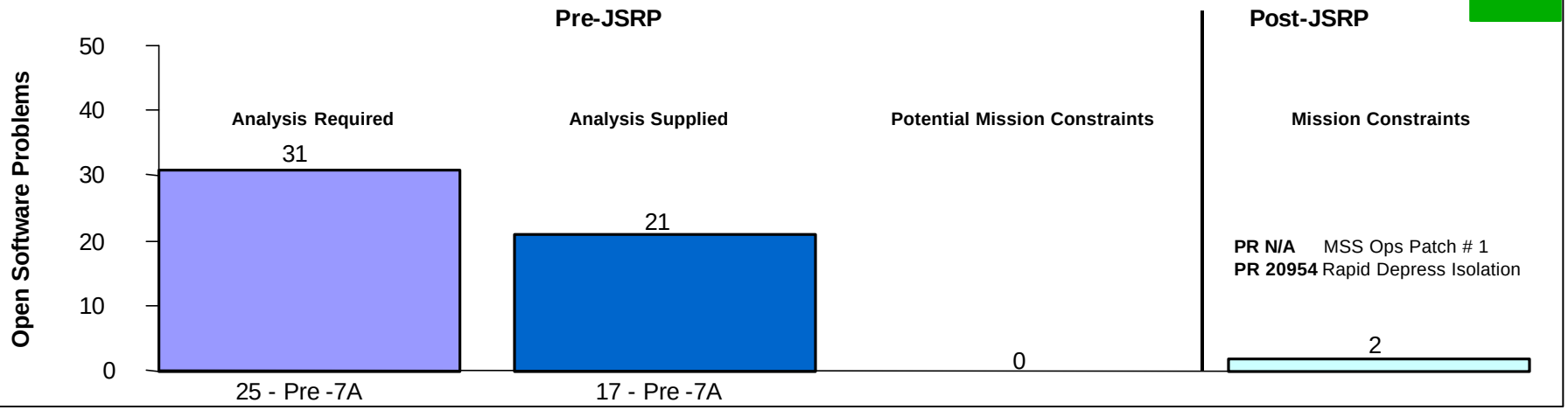
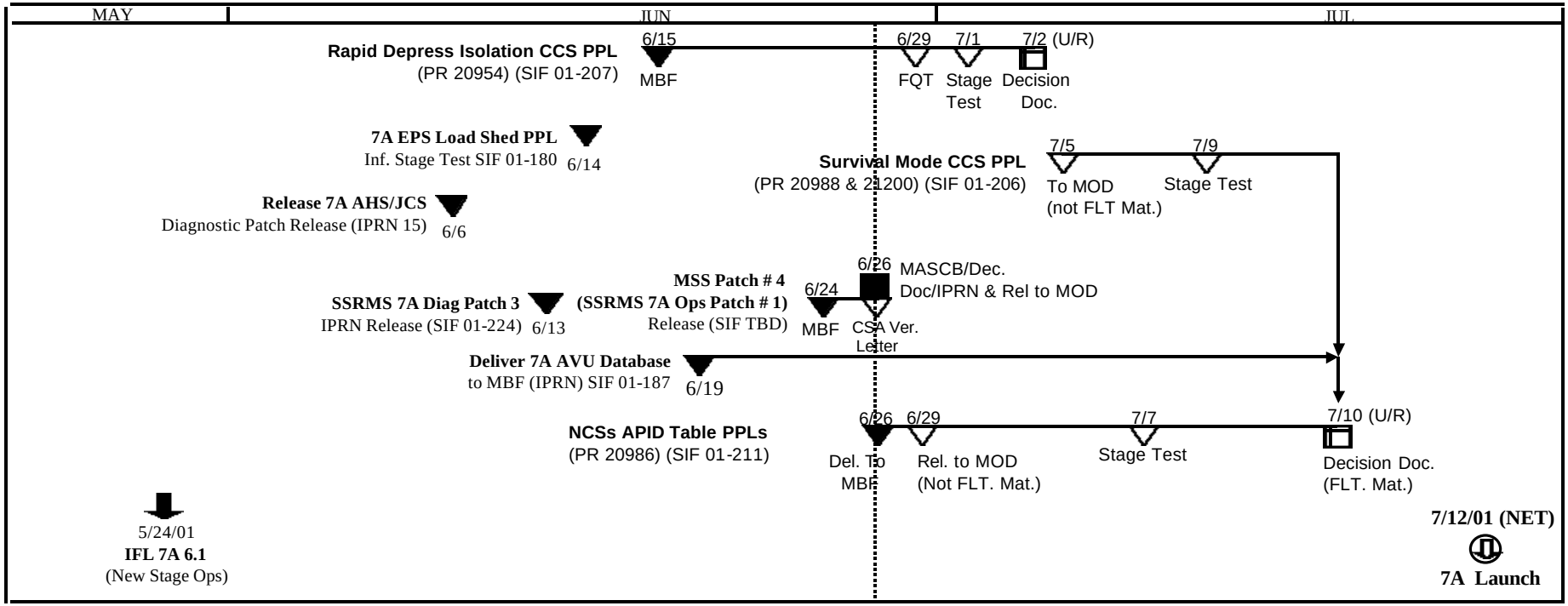


7A FSW Plan to Launch



Certification Results
Software Program Notes

- 619 - Station Program Notes for 7A
    - 38 - new for 7A
  - 587 - ASCB Approved
  - 32 - In work
    - 2 - In Revision
    - 2 - In Review
    - 11 - JSRP Approved
    - 15 - Pending Approval
    - 2 - Created

Summary

- C&C MDM SORR anomaly exception has been closed.
- The ISS Avionics and Software are ready to support the objectives of Flight 7A

Summary

- Flight objectives and priorities are defined
- Flight manifest has been defined
- All hardware and software certification is completed or planned to be complete before L-2
- Personnel and facilities are ready to support
- Hardware delivery and processing schedule support launch date
- US and Russian certification schedule support launch date
- Special topics have been resolved or have acceptable operational workarounds

The ISS Program is Ready to Proceed with the Launch of ISS 7A/STS-104